

in the ordinary way as the real part of $(B - iC)e^{ipt}$ where $i = \sqrt{-1}$, and $p = q - i\gamma$. The value of p is here misprinted $\gamma + iq$. The author then proceeds to find solutions for the case of an indefinitely extended dielectric, and throwing the equations into the form

$$L, M, N = \frac{\partial \xi}{\partial y} - \frac{\partial \eta}{\partial z}, \text{ \&c.,}$$

that is introducing the vector-potential, he goes on to solve the resulting equations for X, Y, Z . Two solutions are obtained of the form

$$\xi = -A \int \frac{u}{r} dx dy dz$$

where (u) may have either of the values u', u'' , given by $u' = f(x', y', z', t)$, $u'' = f(x', y', z', t - Ar)$. Here u' is the value of the x -component of the current at the point (x', y', z') at time t , u'' the value of the same component at the same point at a time previous by the interval required for the light to travel from (x, y, z) to (x', y', z') , r being the distance between these two points. The latter solution is, of course, adapted to the case of propagation in space with velocity $1/A$. It is exemplified by application to the complete solution of Lodge's spherical vibrator. This, in the assumed absence of radiation of energy and frictional damping out of the electrical vibration, may be regarded, for points external to the sphere, as simply a time-periodic electric doublet; for its electrification may be imagined produced by the relative displacement through a small distance of two uniform spherical volume distributions, each of which acts as if its whole charge were situated at its centre. But the existence of radiation very materially affects the result, for if r be the distance of any point from the centre of the vibrator, a the radius of the sphere, ψ a function which gives the electric forces by the equations

$$X = \partial^2 \psi / \partial x \partial z, \quad Y = \partial^2 \psi / \partial y \partial z, \\ Z = -A^2 \partial^2 \psi / \partial t^2 + \partial^2 \psi / \partial z^2,$$

the direction of the axis of the vibrator being that of z then

$$r\psi = Be^{\frac{r}{2a}} e^{-t/2aA} \cos \frac{\sqrt{3}}{2a} \left(r - \frac{t}{A} \right) \\ + Ce^{\frac{r}{2a}} e^{-t/2aA} \sin \frac{\sqrt{3}}{2a} \left(r - \frac{t}{A} \right).$$

This expression is interesting as showing exactly the damping due to radiation in this case; that due to frictional generation of heat is neglected. As $1/A$ is the velocity of light, it will be seen that the radiation damping is exceedingly rapid. This illustrates the difficulty of "maintaining" electric oscillations; and has an important bearing on the interpretation of results obtained with resonators which are damped slowly as compared with the exciters.

Of course, the damping in complicated cases can be found when the total flow of energy through a spherical surface of large radius, surrounding the vibrator, can be computed by Poynting's theorem. Thus it is possible to construct a more accurate solution for points distant from the vibrator, than that given by the supposition of no damping, by thus calculating approximately the exponential factor, and we can go on by successive approximation if need be.

The results obtained by Hert with regard to the period and the damping out of the vibrations of his exciter were

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tested, of course, by his resonator; and we have, in chapter iv. of M. Poincaré's work, an excellent account of the mathematics of resonance, so far as here required, and of the propagation of electric waves along wires, illustrated by reference to the experiments of Sarasin and De la Rive, Blondlot, and others. Many of these have reference to the variation of the current with distance from the end of the wire, at which, of course, reflections took place. The theory, for example, of Mr. D. E. Jones' experiments, in which a thermo-electric couple was used to measure the heating effect at different distances from the end of a long wire, is worked out; and the results, when compared with those of the experiments, are found to agree.

Chapters follow on Propagation in Air, and Applications of Theory. In the latter, M. Poincaré refers, among other things, to the results of the very important experiments of Bjerknes, on waves received by resonators of different metals; that is, their different rates of damping, and the depths to which the currents penetrate into the metal as measured by the thickness (to take an example) of copper, which must be deposited on an iron resonator in order that it may behave like one of solid copper.

These three chapters have a very important bearing on the question of multiple resonance, to which M. Poincaré has himself devoted special attention, and form, perhaps, the most valuable part of the work.

Lastly, the book deals with such applications of electrical oscillations as the determination of specific inductive capacities, the reflection and refraction of electric waves, and ends with a study of Hertz's "Memoir on the Fundamental Equations of Electrodynamics for Moving Bodies."

The mathematical discussions are, as we have indicated, throughout lucid and very frequently elegant. The facility with which an apparently intractable problem is taken hold of, and a few more or less elementary considerations made to yield an approximate solution or result, is very remarkable. We could have wished for a somewhat more physical treatment of the subject; but to those whose physical ideas have had some training with regard to these matters, M. Poincaré's treatise cannot but be of great service, as supplying what no doubt was its object, a review of the principal results obtained in this field of research compared with theory, as far as possible by the only sure test, that of calculation.

A. GRAY.

THE BOOK OF THE ROSE.

The Book of the Rose. By the Rev. A. Foster-Melliard, M.A., Rector of Sproughton, Suffolk. Pp. 336. 29 illustrations. (London: Macmillan and Co., 1894.)

MR. MELLIARD is well known among horticulturists as a successful grower and exhibitor of roses, and his book is what he wished it to be—the rose considered as a flower, with full details for its practical culture for amateurs, from the beginning to the end. Art is his text all through. He has very little to say about the botany of the rose, its geographical distribution, the origin of the numerous races of garden roses as distinguished from their wild progenitors, the fourteen chapters of his book

being devoted to such matters as soil, manure, planting, pruning, propagating, and exhibiting. For the cultivator the book covers all the ground, and Mr. Melliar's instructions are as clear, as thorough, and as trustworthy as any budding "Rosarian" could desire. There are already plenty of books about the rose, of which as much as this can be said, but there is still room for Mr. Melliar's. He writes mainly for the amateur grower of roses, and strongly recommends his hobby to the country parsons who are, he says, "all so poor, and likely to be poorer still." The delights of the rose-grower are only experienced when he himself does all the work entailed in the production of plants from cuttings, buds or seeds, to the exhibition flowers. The genuineness of Mr. Melliar's love for his hobby is seen in the following extract from his book:—

"But if it was you alone who had found, chosen, and grubbed out the [briar] stock from the hedge, or cut, prepared, planted, and transplanted the briar or manetti cutting—if no hand but yours had budded it, cared for it in all stages, and finally cut and shown the Rose—then, when perchance it is declared on all hands to be the finest specimen of the variety ever shown, it must be an additional pleasure to know that it is your Rose indeed, for that, as far as all human aid is concerned, you made it yourself."

If the book has a fault, it is to be found in this treating of the rose solely as a flower to be set on a tray at an exhibition and win a prize. Mr. Melliar has something of the narrowness of view of the old florist, for he sees little beauty in roses which are not likely to win prizes. He devotes thirty pages to instructions on exhibiting the flowers. This chapter is interesting as showing how much care and self-sacrifice are necessary to success in the exhibition tent, the paper covers to protect the buds from rain, wind, and sun, and the precautions necessary even when the flowers are ready to pack in their prepared mossy beds in boxes. In one very dry season, he says, his mossed boxes had been kept in the shade and duly watered, with the result that two huge slugs, each as big as his thumb, concealed themselves in the moss, and during the journey to the Crystal Palace regaled themselves on the roses!

Mr. Melliar speaks of several varieties of rose that show deterioration since they were first introduced, or "sent out," as the raisers express it. These fine varieties of rose are always propagated from grafts or cuttings, and deterioration is therefore unlikely. The same statement has been made with regard to apples, pears, and other fruits, which are multiplied in the same way as roses, but they have never been substantiated.

Until within the last thirty years or so, all the best garden roses were raised by continental growers, the belief being that they could not be produced in England. The same belief prevailed until recently with regard to chrysanthemums. It is therefore a pleasant surprise to see that of the 144 varieties of the Hybrid Perpetual section of roses, selected by Mr. Melliar as the choicest and best, no less than sixty of them were raised in England, and that the two best H.P. roses known, viz. "Her Majesty" and "Mrs. J. Laing," were raised by the late Mr. Bennett in Surrey. To these I would add a third, namely, "Grace Darling," also raised by Mr. Bennett, and

which, although not an exhibition rose, is yet one of the most beautiful of all in the garden. Its only rival is "Gloire de Dijon," raised in France forty years ago, and of which Dean Hole, prince of rosarians said, "Were I condemned to have but one rose for the rest of my life, I should ask, before leaving the dock, to be presented with a strong plant of 'Gloire de Dijon.'"

A book which deals chiefly with exhibition roses can scarcely be considered to justify its title, "The Book of the Rose," because to all but a very small section of gardeners the rose appeals with greatest force when seen as a naturally grown bush in the garden. The close pruning and other rigorous methods of the grower-exhibitor are suggestive of ear-cropping for dogs, and comb-cutting for cocks, disfiguring, for a special purpose, otherwise beautiful objects. Mr. Melliar has very little to say for the many beautiful single-flowered roses which are now coming rapidly into favour with gardeners, and whose flowers are often as lovely as the highest floral art could wish. Many of the perfect exhibition roses are just about as attractive in form and colour as a red-cabbage. The hybrids raised by Lord Penzance from the sweetbriar crossed with garden roses, are exceedingly beautiful, so too are the forms of the Japanese *Rosa rugosa*, *R. multiflora*, *R. bracteata*, *R. indica*, &c.

It is becoming a too common practice amongst professional gardeners to set about crossing beautiful species of plants, roses included, with a view to doubling or otherwise altering the form, or "improving" the colour of the flowers, to satisfy some absurd ideal, the consequence often being a considerable loss from the point of view of true art. We owe the garden roses of the present time to the breeders of florists' flowers, and are duly thankful. At the same time we would prefer to keep the best of the single-flowered roses just as they are. Mr. Melliar does not agree with those who look upon the rose as a decorative plant for the garden, but only as a means whereby he may obtain glorious roses. For me, the best tray of exhibition roses ever produced has infinitely less charm than a bed of yellow Banksian roses, or even a tangled mass of sweetbriar when covered with flowers. However, Mr. Melliar's book will teach any one how to grow good rose flowers, and there are thousands who would find pleasure in rose-growing by reading and following his directions.

W.

OUR BOOK SHELF.

L'Industrie des Araneina. By Woldemar Wagner. (St. Petersburg: L'Académie Impériale des Sciences, 1894.)

THIS work may be divided into two sections: (1) the descriptions of the cocoons, nests, &c., of the commoner kinds of Russian spiders; and (2) the conclusions respecting the evolution of instincts and the classification of the species, to be drawn from the data thus established.

Wagner recognises four kinds of silken structures—namely, the snare, the retreat, the nest, and the cocoon. About the first of these but little is said. The remaining three, however, are discussed in considerable detail, and to the question as to whether these structures are of great taxonomic value, M. Wagner gives an unhesitating and most positive affirmative reply. It is unfortunately impossible within the limits of a short notice to criticise